Jefferson Lab Experiment 98-101

Spin Polarization in Kaon Electroproduction

This is an experiment to study spin polarization observables in kaon electroproduction. The experiment will use a longitudinally polarized electron beam, an unpolarized hydrogen target, and will be sensitive to the Λ-hyperon recoil polarization. In the electromagnetic production of kaons from a proton, $e + p \rightarrow e' + K^+ + \Lambda$, the associated Λ-hyperon will be identified by its missing mass in the reaction, and the decay proton from the hyperon ($\Lambda \rightarrow p + \pi^-$) will be detected. Because the Λ-hyperon decay is self-analyzing, a measurement of the proton momentum distribution may be used to determine the hyperon spin polarization vector. Thus the experiment will serve to elucidate the process of polarization transfer from the polarized electron to the Λ-hyperon as well as induced hyperon polarization which results even for an unpolarized beam. (Induced polarization has been studied previously using real photons. However, this will be the first measurement of that quantity at nonzero momentum transfer.)

The cross sections $\sigma_{TT'}$ and $\sigma_{LT'}$ will be measured for squared four-momentum-transfer, Q^2, from 0.5 to 2.1 $(GeV/c)^2$. Additionally, because the hyperon recoil polarization will be measured simultaneously, the polarization transfer response functions, $R_{TT'}$ and $R_{LT'}$ will be determined in this same kinematic range. Kaons (hyperons) will be detected along (opposite to) the momentum-transfer direction in the center-of-mass frame. In the laboratory frame, both kaon and hyperon momentum vectors lie parallel to the momentum transfer direction. The experiment will be carried out with standard equipment in Hall C, viz., the cryogenic unpolarized (liquid) hydrogen target, and the HMS and the SOS with the same detector packages that were used in the kaon electroproduction experiments which were completed in the fall of 1996.

Spin observables may be used to shed light on the hyperon spin structure and the spin dependence of the partonic fragmentation and recombination processes. Additionally, the response functions $R_{TT'}$ and $R_{LT'}$ exhibit some sensitivity to the Λ-hyperon electromagnetic form factor at nonzero Q^2 ($Q^2 0$). Presently, this is the best way to measure hyperon form factors for large space-like momentum transfer.